Notice No.5

Rules and Regulations for the Classification of Ships, July 2016

The status of this Rule set is amended as shown and is now to be read in conjunction with this and prior Notices. Any corrigenda included in the Notice are effective immediately.

Issue date: December 2016

Amendments to	Effective date	Mandatory Instrument
Part 5, Chapter 2, Section 2	1 January 2017	
Part 5, Chapter 6, Sections 2 & 5	1 January 2017	X
Part 5, Chapter 8, Section 2	1 January 2017	X
Part 5, Chapter 12, Sections 1, & 9	1 January 2017	
Part 5, Chapter 12, Sections 2 & 7	1 January 2017	X
Part 5, Chapter 13, Section 12	1 January 2017	X
Part 5, Chapter 15, Section 4	1 January 2017	X
Part 5, Chapter 25, Sections 1 to 12	1 January 2017	X
Part 6, Chapter 1, Section 1	1 January 2017	
Part 6, Chapter 2, Sections 1, 9, 11, 14 & 21	1 January 2017	
Part 7, Chapter 11, Section 3	1 January 2017	X

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Part 5, Chapter 2
Reciprocating Internal Combustion Engines

■ *Section 2*
Materials and Components

2.2 Test and inspections

(*Part only shown*)

Table 2.2.1 Summary of documentation and testing for engine components

Part	Material properties *see* Note 2	Non-destructive examination	Hydraulic testing *see Pt 5,Ch 2, 2.3 Hydraulic tests 2.3.1*	Dimensional inspection *see* Note 3	Visual inspection	Applicable to engines	LR Component Certification *see* Note 4
Accumulator of common rail fuel or servo oil system *see* Note 14	C + M	-	~~P~~ Lesser of $1,5p$ or p+300 bar	-	-	Accumulators with a capacity >0,5l	-

2.5 Autofrettage

2.5.1 Manufacturers, and external providers of products or services, who carry out autofrettage of engine components, are to ~~be~~ apply an approach for product assurance that is ~~approved~~ accepted by LR.

2.5.3 Testing carried out as part of the approach for product assurance is to confirm that the autofrettage process has not detrimentally affected the components and demonstrate that the prescriptive ~~rule~~ Rule requirements for pressure containment have been met, *see Table 2.2.1 Summary of documentation and testing for engine components*.

Part 5, Chapter 6
Main Propulsion Shafting

■ *Section 2*
Materials

2.1 Materials for shafts

2.1.4 Where materials with greater specified or actual tensile strengths than the limitations given above are used, reduced shaft dimensions or higher permissible vibration stresses are not acceptable when derived from the formulae used in *Pt 5, Ch 6, 3.1 Intermediate shafts, Pt 5, Ch 6, 3.5 Screwshafts and tube shafts, Pt 5, Ch 6, 3.6 Hollow shafts* and *Pt 5, Ch 8, 2.5 Limiting stress in propulsion shafting* unless, for intermediate shafts only, it is verified that the materials exhibit a similar fatigue life to conventional steels through compliance with the requirements in *Pt 5, Ch 6, 5 Approval of alloy steel used for intermediate shaft material*.

■ *Section 5*
Approval of alloy steel used for intermediate shaft material

5.1 Application

5.1.1 The requirements of *Section 5* are, in addition to the requirements of the *Rules for the Manufacture, Testing and Certification of Materials*, *Ch 5*, *3 Forgings for shafting and machinery*, to be applied to the approval of alloy steel which has a minimum specified tensile strength greater than 800 N/mm^2, but, not exceeding 950 N/mm^2 intended for use as intermediate shaft material.

5.2 Torsional fatigue test

5.2.1 A torsional fatigue test is to be performed to verify that the material exhibits a similar fatigue life to conventional steels. The torsional fatigue strength of the material is to be equal to or greater than the permissible torsional vibration stress τ_c given by the formulae in *Pt 5, Ch 8, 2.5 Limiting stress in propulsion shafting*.

5.2.2 The test is to be carried out with notched and unnotched specimens respectively. For calculation of the stress concentration factor of the notched specimen, fatigue strength reduction factor β should be evaluated in consideration of the severest torsional stress concentration factor in the design criteria.

5.2.3 Test procedures are to be in accordance with Section 10 of ISO 1352 and the test conditions applied are to be in accordance with *Table 6.5.1 Test condition*. Mean surface roughness is to be less than 0,2μm Ra with the absence of localised machining marks verified by visual examination at low magnification (x20) as required by Section 8.4 of ISO 1352.

Table 6.5.1 Test Condition

Loading type	Torsion
Stress ratio	*R* = -1
Load waveform	Constant amplitude sinusoidal
Evaluation	S-N curve
Number of cycles for test termination	1 x 10^7

5.2.4 The measured torsional fatigue strength for continuous operation, τ_c, and torsional fatigue strength for transient operation, τ_t, are to be equal to or greater than the values given by the following formulae:

$$\tau_c \geq \frac{\sigma_u + 160}{6} . C_k . C_d \quad \text{for } r = 0$$

$$\tau_t \geq 1.7 . \tau_c . \frac{1}{\sqrt{C_k}}$$

Where

C_k = a factor for different shaft design features, *see Table 8.2.1 C_k factors, Pt 5, Ch 8, 2.4 Symbols and definitions 2.4.4*

C_d = size factor, *see Pt 5, Ch 8, 2.4 Symbols and definitions, 2.4.1*

σ_u = specified minimum tensile strength of the shaft material, in N/mm^2

r = speed ratio, N/N_s, *see Pt 5, Ch 8, 2.4 Symbols and definitions, 2.4.1*

5.3 Material requirements

5.3.1 The steels are to have a degree of cleanliness as shown in *Table 6.5.2 Cleanliness requirements* when tested according to ISO 4967 method A. Representative samples are to be obtained from each heat of forged or rolled products.

Table 6.5.2 Cleanliness requirements

Inclusion group	Series	Limiting chart diagram index I
Type A	Fine	1
	Thick	1
Type B	Fine	1,5
	Thick	1
Type C	Fine	1
	Thick	1
Type D	Fine	1
	Thick	1
Type DS	–	1

Part 5, Chapter 8
Shaft Vibration and Alignment

■ *Section 2*
Torsional vibration

2.5 Limiting stress in propulsion shafting

2.5.4 In general, the tensile strength of the steel used is to comply with the requirements of *Pt 5, Ch 6, 2 Materials*. For the calculation of the permissible limits of stresses due to torsional vibration, σ_u is not to be taken as more than 800 N/mm^2 in the case of alloy steel intermediate shafts, or 600 N/mm^2 in the case of carbon and carbon-manganese steel intermediate, thrust and propeller shafts unless, for intermediate shafts only, it is verified that the materials exhibit a similar fatigue life to conventional steels through compliance with the requirements in *Pt 5, Ch 6, 5 Approval of alloy steel used for intermediate shaft material.*

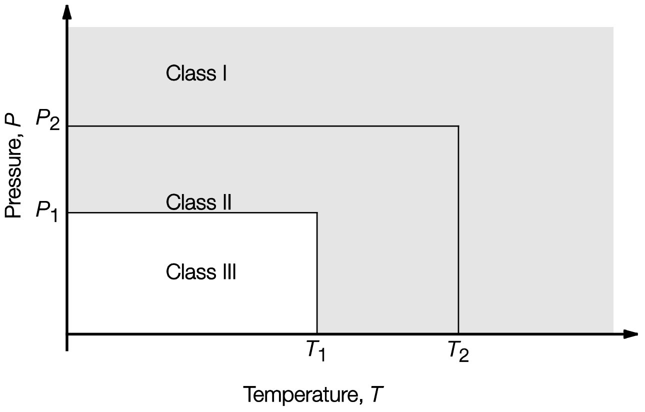
Part 5, Chapter 12
Piping Design Requirements

■ *Section 1*
General

1.6 Classes of ~~pipes~~ piping systems and components

1.6.1 Pressure piping systems are divided into three classes for the purpose of assigning appropriate testing requirements, types of joints to be adopted, heat treatment and weld procedure.

1.6.2 Dependent on the service for which they are intended, Class II and III pipes are not to be used for design pressure or temperature conditions in excess of those shown in *Table 12.1.1 Maximum pressure and temperature conditions for Class II and III piping systems*. Where either the maximum design pressure or temperature exceeds that applicable to Class II pipes, Class I pipes are to be used. To illustrate this, *see Figure 12.1.1 Classes of piping system*.



NOTE
T_1 and P_1 correspond to the maximum temperatures and pressures for a Class III piping system and T_2 and P_2 to those for a Class II piping system depending on the service.

Figure 12.1.1 Classes of piping system

Table 12.1.1 Maximum pressure and temperature conditions for Class II and III piping systems

Piping system	Class II		Class III	
	~~p~~ P_2	T_2	~~p~~P_1	T_1
	bar	°C	bar	°C
Steam	16,0	300	7,0	170
Thermal oil	16,0	300	7,0	150
Flammable Liquids, *see* Note 1	16,0	150	7,0	60
Other media, *see* Note 2	40,0	300	16,0	200
Cargo oil	40,0	300	16,0	200

Note *1* Flammable liquids include; fuel oil, lubricating oil and flammable hydraulic oil.
~~**Note** *2* For grey cast iron, *see also Pt 5, Ch 12, 4.2 Grey cast iron* 4.2.2.~~
Note *2* Including water, air, gases, non-flammable hydraulic oil.

1.6.3 In addition to the pressure piping systems in *Table 12.1.1 Maximum pressure and temperature conditions for Class II and III piping systems*, Class III pipes may be used for open ended piping, e.g. overflows, vents, boiler waste steam pipes, open ended drains, sounding pipes, etc.

1.6.4 Class II and III pipes are not to be used for toxic media.

1.6.5 Class I pipes are generally required for corrosive media. Class II pipes may be used for corrosive media where special safeguards for reducing the potential for leakage and limiting its consequences are provided, e.g. the use of pipe ducts, shielding, screening, etc. in such a way that a leakage will not cause a potential hazard or damage to surrounding areas. Class III pipes are not to be used for corrosive media. Materials used for piping for corrosive media are to be specially considered.

1.6.6 For piping systems or components using cast iron, *see Pt 5, Ch 12, 4 Cast iron*.

1.7 Materials

1.7.1 Materials for ~~ferrous~~metallic castings and forgings of Class I and Class II piping systems are to be produced at a works approved by Lloyd’s Register (~~hereinafter~~commonly referred to as ‘LR’) and are ~~in general~~ to be tested in accordance with the *Rules for the Manufacture, Testing and Certification of Materials* (~~hereinafter~~ commonly referred to as the Rules for Materials).

■ *Section 2*

Carbon and low alloy steels

2.12 Other mechanical couplings

2.12.1 Pipe unions, compression couplings, ~~and~~ or slip-on joints, as shown in ~~*Pt 5, Ch 12, 2.12 Other mechanical couplings 2.12.1*~~ ~~and~~ ~~*Pt 5, Ch 12, 2.12 Other mechanical couplings 2.12.1*~~ *Figure 12.2.4 Examples of mechanical joints (Part 1)* and *Figure 12.2.5 Examples of mechanical joints (Part 2)*, may be used if Type Approved for the service conditions and the intended application. The Type Approval is to be based on the results of testing of the actual joints. The acceptable use for each service is indicated in *Table 12.2.7 Application of mechanical joints* and dependence upon the Class of piping, with limiting pipe dimensions, is indicated in *Table 12.2.8 Application of mechanical joints depending on class of piping*.

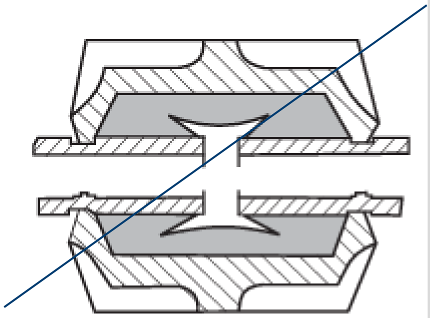
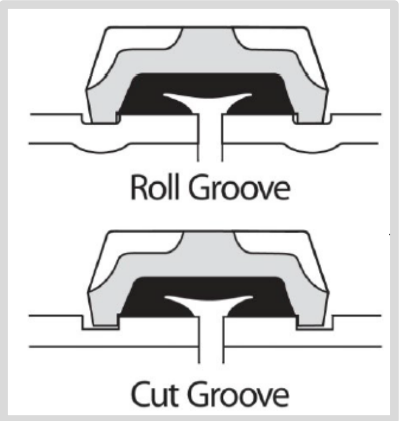
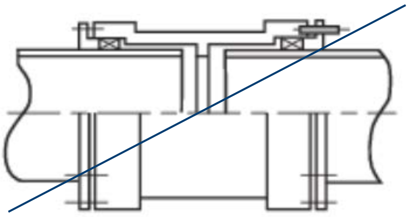
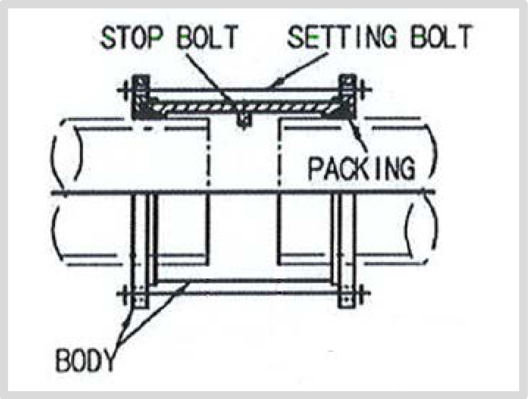
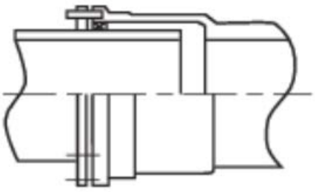
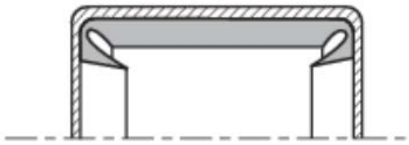
Machine Grooved Type	 
Slip Type	   

Figure 12.2.5 Examples of mechanical joints (Part 2) ***(Part only shown)***

Table 12.2.7 Application of mechanical joints

Systems	~~Kind~~Type of connections		
	Pipe unions	Compression couplings ~~(6)~~	Slip-on joints
Flammable fluids (Flash point <60°)			
Cargo oil lines *see* Note 4	+	+	+~~5~~
Crude oil washing lines *see* Note 4	+	+	+~~5~~
Vent lines *see* Note 3	+	+	+~~3~~
Inert gas			
Water seal effluent lines	+	+	+
Scrubber effluent lines	+	+	+
Main lines *see* Notes 2 & 4	+	+	+~~2,5~~
Distribution lines *see* Note 4	+	+	+~~5~~
Flammable fluids (Flash point > 60°)			
Cargo oil lines *see* Note 4	+	+	+~~5~~
Fuel oil lines *see* Notes 2 & 3	+	+	+~~2,3~~
Lubricating oil lines *see* Notes 2 & 3	+	+	+~~2,3~~
Hydraulic oil *see* Notes 2 & 3	+	+	+~~2,3~~
Thermal oil *see* Notes 2 & 3	+	+	+~~2,3~~
Sea-water			
Bilge lines *see* Note 1	+	+	+~~1~~
Water filled fire-extinguishing systems, e.g. sprinkler systems *see* Note 3	+	+	+
Non-water filled fire-extinguishing systems, e.g. foam, drencher systems *see* Note 3	+	+	+
Fire main ~~and water spray~~ (not permanently filled) *see* Note 3	+	+	+~~3~~
~~Foam system~~	~~+~~	~~+~~	~~+3~~
~~Sprinkler system~~	~~+~~	~~+~~	~~+3~~
Ballast system *see* Note 1	+	+	+~~1~~
Cooling water system *see* Note 1	+	+	+~~1~~
Tank cleaning services	+	+	+
Non-essential systems	+	+	+
Fresh water			
Cooling water system *see* Note 1	+	+	+~~1~~
Condensate return *see* Note 1	+	+	+~~1~~
Non-essential system	+	+	+
Sanitary/Drains/Scuppers			
Deck drains (internal) *see* Note 6	+	+	+4
Sanitary drains	+	+	+
Scuppers and discharge (overboard)	+	+	-
Sounding/vent			
Water tanks/Sewage tanks/Dry spaces	+	+	+
Oil tanks (f.p.> 60°C) *see* Notes 2 & 3	+	+	+~~2,3~~
Miscellaneous			
Starting/Control air ~~(1)~~ *see* Note 1	+	+	-
Service air (non-essential)	+	+	+
Brine	+	+	+
CO_2 system *see* Note 1	+	+	-
Steam	+	+	+~~7~~ *see* Note 5

KEY

+ Application is allowed
- Application is not allowed

Note 1. ~~Inside machinery spaces of category A~~ Mechanical joints that include any components which readily deteriorate in case of fire, are to be of an approved fire-resistant type when fitted in machinery spaces of category A. Mechanical couplings fitted on the ‘bilge main’ in machinery spaces of category A are to be of steel or equivalent material.~~- only approved fire resistant types.~~
Note 2. Mechanical joints that include any components which readily deteriorate in case of fire are ~~Not~~ not permitted in~~side~~ machinery spaces of category A or accommodation spaces. Mechanical joints that include any components which readily deteriorate in case of fire that are of an approved fire-resistant type ~~May~~may be ~~accepted~~fitted in other machinery spaces provided the joints are located in easily visible and accessible positions.
Note 3. ~~Approved fire resistant types~~ Mechanical joints that include any components which readily deteriorate in case of fire fitted on fuel oil lines are to be of an approved fire-resistant type. Mechanical joints that include any components which readily deteriorate in case of fire fitted on other systems are to be of an approved fire-resistant type except when fitted on open decks having little or no fire risk as defined in SOLAS II-2/Reg. 9.2.3.3.2.2(10). ~~Fire resistant type is a type of connection which, when installed in the system and in the event of failure caused by fire, the failure would not result in fire spread, flooding or the loss of an essential service.~~
~~**Note** 4. Above freeboard deck only.~~
Note ~~5~~4. Mechanical joints that include any components which readily deteriorate in case of fire are to be of an approved fire-resistant type when fitted ~~In~~in pump rooms and on open decks~~ - only approved fire resistant types~~.
Note ~~7~~5*. See Pt 5, Ch 12, 2.12 Other mechanical couplings 2.12.~~11~~10.*
~~**Note** 6. If compression couplings include any components which are sensitive to heat, they are to be of approved fire resistant type as required for slip-on joints.~~
Note 6. Mechanical joints are only permitted above bulkhead deck of passenger ships and freeboard deck of cargo ships.

2.12.2 Where the application of mechanical joints results in a reduction in pipe wall thickness due to the use of bite type rings or other structural elements, this is to be taken into account in determining the minimum wall thickness of the pipe to withstand the design pressure.

~~2.12.3 Construction of mechanical joints is to prevent the possibility of tightness failure affected by pressure pulsation, piping vibration, temperature variation and other similar adverse effects occurring during operation on board.~~

~~2.12.4~~ 2.12.3 Materials of mechanical joints are to be compatible with the piping material and internal and external media.

~~2.12.5~~ 2.12.4 Mechanical joints for pressure pipes are to be tested to a burst pressure of 4 times the design pressure. For design pressures above 200 bar the required burst pressure will be specially considered.

~~2.12.6 In general, mechanical joints are to be of fire-resistant type where required by *Table 12.2.7 Application of mechanical joints*.~~

~~2.12.7~~ 2.12.5 Mechanical joints, which in the event of damage could cause fire or flooding, are not to be used in piping sections directly connected to the ~~sea openings~~ ship’s side below the bulkhead deck of passenger ships and freeboard deck of cargo ships or tanks containing flammable fluids.

~~2.12.8~~ 2.12.6 The mechanical joints are to be designed to withstand internal and external pressure as applicable and where used in suction lines are to be capable of operating under vacuum.

2.12.7 The number of mechanical joints in flammable fluid systems is to be kept to a minimum. In general, flanged joints are to conform to a recognised standard.

~~2.12.9~~ 2.12.8 Generally, slip-on joints are not to be used in pipelines in cargo holds, tanks, and other spaces which are not easily accessible. Application of these joints inside tanks may only be accepted where the medium conveyed is the same as that in the tanks.

~~2.12.10~~ 2.12.9 ~~Unrestrained slip-on joints are only to be used in cases where compensation of lateral pipe deformation is necessary.~~ Usage of slip type slip-on ~~these~~ joints as the main means of pipe connection is not permitted except for cases where compensation of axial pipe deformation is necessary.

~~2.12.11~~ 2.12.10 Restrained slip-on joints are permitted in steam pipes with a design pressure of 10 bar or less on the weather decks of oil and chemical tankers to accommodate axial pipe movement, *see Pt 5, Ch 13, 2.7 Provision for expansion*.

~~2.12.12~~ 2.12.11 Mechanical joints are to be tested in accordance with the test requirements of LR’s Type Approval Test Specification Number 2, as relevant to the service conditions and the intended application. The programme of testing is to be agreed with LR.

2.14 Carbon dioxide (CO_2) fire-extinguishing system piping

2.14.2 Materials for the distribution manifolds between the carbon dioxide storage bottles and the discharge valves to each section and associated pipes, valves and fittings of high pressure systems are to be manufactured and tested in accordance with the requirements for Class I piping systems. Pipes are to meet the minimum wall thickness requirements of *Table ~~12.2.4~~ 12.2.9 Minimum thickness for steel pipes for CO_2 fire-extinguishing* and the manifold system is to be hydraulically tested to a pressure of 190 bar. A high pressure system is defined as a system where the carbon dioxide is stored at ambient temperature.

Materials for the distribution manifolds between the carbon dioxide storage vessel(s) and the discharge valves to each section and associated pipes, valves and fittings of low pressure systems are to be manufactured and tested in accordance with the requirements for Class II piping systems and the manifold system is to be hydraulically tested to a pressure of 33 bar. A low pressure system is defined as a system where the carbon dioxide is stored at a working pressure in the range of ~~1,8 N/mm² to 2,2 N/mm²~~ 18 bar to 22 bar.

2.14.3 Piping downstream of the distribution valve(s) for high pressure systems is to be manufactured and tested in accordance with the requirements for Class II piping and is to meet the minimum wall thickness requirements of *Table ~~12.2.4~~ 12.2.9 Minimum thickness for steel pipes for CO_2 fire-extinguishing*. After installation the distribution system is to be leak tested at a pressure of 6 bar.
Piping downstream of the distribution valve(s) for low pressure systems is to be manufactured and tested in accordance with the requirements for Class III piping. After installation the distribution system is to be leak tested at a pressure of 6 bar. Class III piping may be used for open ended distribution piping downstream of the distribution valve(s) of high pressure systems where agreed by LR and where meeting the minimum wall thickness requirements of *Table ~~12.2.4~~ 12.2.9 Minimum thickness for steel pipes for CO_2 fire-extinguishing* and where a minimum of ten per cent of the piping is hydraulically tested at a pressure of 125 bar. This testing is to be carried out before installation.

Table 12.2.9 Minimum thickness for steel pipes for CO_2 fire-extinguishing

External diameter *D*, in mm	Minimum thickness, in mm	
	From bottles to distribution station	From distribution station to nozzles
21,3 - 26,9	3,2	2,6
30 - 48,3	4	3,2
51 - 60,3	4,5	3,6
63,5 - 76,1	5	3,6
82,5 - 88,9	5,6	4
101,6	6,3	4
108 - 114,3	7,1	4,5
127	8	4,5
133 - 139,7	8	5
152,4 - 168,3	8,8	5,6

Note 1. Pipes are to be galvanized at least inside, except those fitted in the engine room where galvanizing may not be required at the discretion of LR. Effects of galvanising shall be taken into account in the relevant calculations e.g. volume flow.
Note 2. For threaded pipes, where allowed, the minimum wall thickness is to be measured at the bottom of the thread.
Note 3. The external diameters and thicknesses have been selected from ISO Recommendations R336 for smooth welded and seamless steel pipes. Diameter and thickness according to other national or international standards may be accepted.
Note 4. For larger diameters the minimum wall thickness will be subject to special consideration by LR.
Note 5. In general the minimum thickness is the nominal wall thickness and no allowance need be made for negative tolerance or reduction in thickness due to bending.

■ *Section 7*
Flexible hoses

7.3 Design requirements

7.3.1 Flexible hose assemblies are to be designed and constructed in accordance with recognised National or International Standards acceptable to LR.

7.3.2 Flexible hoses are to be complete with approved end fittings in accordance with manufacturer's specification. End connections which do not have flanges are to comply with *Pt 5, Ch 12, 2.12 Other mechanical couplings* as applicable and each type of hose/fitting combination is to be subject to prototype testing to the same standard as that required by the hose with particular reference to pressure and impulse tests.

7.3.3 Flexible hose assemblies intended for installation in piping systems where pressure pulses and/or high levels of vibration are expected to occur in service, are to be designed for the maximum expected impulse peak pressure and forces due to vibration. The tests required by *Pt 5, Ch 12, 7.4 Testing* are to take into consideration the maximum anticipated in-service pressures, vibration frequencies and forces due to installation.

7.3.4 Flexible hose assemblies constructed of non-metallic materials intended for installation in piping systems for flammable media, and sea-water systems where failure may result in flooding, are to be of fire-resistant type. Non-metallic flexible hoses used for sea water systems and flammable media, except fuel oil, installed on open decks having little or no fire risk as defined in SOLAS II-2/Reg. 9.2.3.3.2.2(10) are not required to be of fire-resistant type. Fire resistance is to be demonstrated by testing to ISO 15540 and ISO 15541.

7.3.5 Flexible hose assemblies are to be suitable for the intended location and application, taking into consideration ambient conditions, compatibility with fluids under working pressure and temperature conditions consistent with the manufacturer's instructions and any other applicable requirements in the Rules.

■ *Section 9*

Piping for LPG/LNG carriers, gas fuelled ships and classed refrigeration systems

9.3 Classes of ~~pipe~~piping system and components

9.3.1 The material requirements for piping systems vary depending on the Class of the piping system. The Class of the piping system is dependent on the design pressure or temperature of the system and the pipe material used ~~as shown in *Table 12.1.1 Maximum pressure and temperature conditions for Class II and III piping systems*~~, *see Pt 5, Ch 12, 1.6 Classes of piping and components*.

9.3.3 For reliquefaction and refrigeration systems ~~*Table 12.1.1 Maximum pressure and temperature conditions for Class II and III piping systems* is~~ the requirements of *Pt 5, Ch 12*, *1.6 Classes of piping systems and components* are to be applied. Nitrogen and non-toxic or nonflammable refrigerants are to be considered under the ‘Other media’ heading. Refrigeration systems containing ammonia are to be considered as Class I systems irrespective of the operational pressure.

Part 5, Chapter 13
Ship Piping Systems

■ *Section 12*

Air, overflow and sounding pipes

12.7 Air pipe closing appliances

12.7.11 The inner and the outer chambers of an automatic air pipe head are to be of a minimum thickness of 6 mm. Where side covers are provided, and their function is integral to providing functions of the closing device as outlined in *Pt 5, Ch 13, 12.7 Air pipe closing appliances 12.7.1*, they shall have a minimum wall thickness of 6 mm. If the air pipe head can meet the tightness test in LR’s Type Approval Test Specification Number 2 without the side covers attached, then the side covers are not considered to be integral to the closing device, in which case a wall thickness less than 6 mm will be accepted.

Part 5, Chapter 15
Piping Systems for Oil Tankers

■ *Section 4*

Cargo tank venting, purging and gas-freeing

4.1 Cargo tank venting

4.1.2 The venting arrangements are to be so designed and operated as to ensure that neither pressure nor vacuum in cargo tanks exceeds design parameters and are to be such as to provide for:

(a) the flow of the small volumes of vapour, air or inert gas mixtures caused by thermal variations in a cargo tank in all cases through pressure/vacuum valves~~.~~; and

(b) the passage of large volumes of vapour, air or inert gas mixtures during cargo loading and ballasting, or during discharging.

(c) a secondary means of allowing full flow relief of vapour, air or inert gas mixtures to prevent overpressure or underpressure in the event of failure of the arrangements in *Pt 5, Ch 15, 4.1 Cargo tank venting 4.1.2*. In addition, the secondary means shall be capable of preventing overpressure or underpressure in the event of damage to, or inadvertent closing of, the means of isolation required in *Pt 5, Ch 15, 4.1 Cargo tank venting 4.1.4* and *Pt 5, Ch 15, 4.1 Cargo tank venting 4.1.5*. Alternatively, pressure sensors may be fitted to monitor the pressure in each tank protected by the arrangement required in *Pt 5, Ch 15, 4.1 Cargo tank venting 4.1.2*, with a monitoring system in the ship's cargo control room or the position from which cargo operations are normally carried out. Such monitoring equipment is also to provide an alarm facility, which is activated by detection of ~~over-pressure or under-pressure~~ overpressure or underpressure conditions within a tank.

Part 5, Chapter 25
Ballast Water Treatment System and Installation

■ *Section 1*
General

1.1 Purpose and Scope

1.1.2 The Rules are intended to ensure that the design, construction and installation of the BWTS achieve a level of safety which is acceptable to Lloyd's Register (LR) and, additionally, to ensure that a failure of the BWTS will not affect the operation of essential ~~ship systems~~ services.

1.2 Definitions

1.2.1 Where any of the terms contained within this Section are used within this Chapter, their meaning is to be as defined in *Pt 5, Ch 25, 1.2 Definitions 1.2.2* to *Pt 5, Ch 25, 1.2 Definitions* ~~*1.2.16*~~ *1.2.17*.

1.2.5 **Dangerous gas** – refers to any gas which may develop an explosive and/or toxic atmosphere, e.g. hydrogen (H_2), hydrogen sulphide (H_2S), hydrocarbon gas, ozone (O_3), chlorine (Cl_2), chlorine dioxide (ClO_2), etc.

Existing paragraphs 1.2.5 *to* 1.2.16 *have been renumbered* 1.2.6 *to* 1.2.17.

1.3 Class notations

1.3.1 **BWTS** notation assigned to ships with a BWTS which is approved and installed in accordance with LR's Rules and Regulations.

1.3.2 **BWTS*** notation assigned to ships with a BWTS which is Type Approved in accordance with LR's Type Approval procedures and approved and installed in accordance with LR's Rules and Regulations.

■ *Section 2*
Functional requirements

2.1 General

2.1.2 Failure of the BWTS is not to impair essential ~~systems~~ services as defined by, but not limited to, *Pt 6, Ch 2, 1.6 Definitions*.

■ *Section 3*
Performance requirements

3.1 General

3.1.1 The ~~Ballast Water Treatment System~~ BWTS is to be able to treat the ballast capacity of the vessel. ~~Where specific requirements or conditions are to be maintained for the effectiveness of BWTS the safety of the ship is not to be compromised.~~ The ballast capacity shall be described either in terms of flowrate or volume depending on the type of BWTS.

3.1.2 Where it is possible that a vacuum may occur in the ballast line, a suitable means of protection is to be provided, e.g. Pressure/Vacuum (P/V) valves or breather valves. For such ballast lines from ballast tanks in hazardous areas, P/V or breather valve outlets are to be led to an area on open deck with no ignition hazard.

~~3.1.5~~ 3.1.6 By-pass and isolation arrangements are to be provided for BWTS as required in ~~*Pt 5, Ch 25, 11.3 By-pass and isolation arrangement*~~ *Pt 5, Ch 25, 11.2 Installation requirements*.

Existing paragraphs 3.1.2 *to* 3.1.8 *have been renumbered* 3.1.3 *to* 3.1.9.

■ *Section 4*
Documentation required for appraisal

4.1 Ballast Water Treatment System appraisals

4.1.8 Report of risk-based studies, as applicable, *see Pt 5, Ch 25, 6.2 Risk assessment of BWTS*.

■ *Section 5*
Materials

5.1 General

5.1.3 Materials used for ~~construction of~~ chemical storage tanks and associated piping systems are to be resistant to such chemicals and constructed in accordance with the *Rules and Regulations for the Construction and Classification of Ships for the Carriage of Liquid Chemicals in Bulk* (hereinafter referred to as the Rules for Ships for Liquid Chemicals), as applicable.

5.1.4 Non-metallic materials which do not comply with the fire endurance test requirements given in *Pt 5, Ch 12, 5.4 Fire performance criteria*, may be used in BWTS provided that the system can be remotely isolated from other ship systems by isolation valves which are of steel construction, including the remote actuator, or of an acceptable fire tested design. The control of isolation valves is to be designed in accordance with the characteristics of fail-safe operation.

■ *Section 6*
Risk-based studies

6.1 Purpose

6.1.2 The risk-based studies are to be undertaken in accordance with LR's ShipRight procedure, ~~*Assessment of*~~ *Risk Based Designs* and associated annexes.

6.2 Risk Assessment of BWTS

6.2.6 BWTS using treatment methods such as heat, low pressure boiling, ultraviolet irradiation etc. are to comply with the applicable requirements in this Chapter.

6.2.7 BWTS using treatment methods which use or produce harmful or dangerous substances such as biocides, ozone, chlorine, hydrogen, etc. are to be subject to a risk assessment.

6.3 Risk assessment of BWTS installation

6.3.2 The risk assessment is to focus on, but not be limited to, risks which may affect safety of persons and the reliable operation of essential ~~ship systems~~ services associated with operation of the BWTS under all normal and abnormal conditions. As a minimum the following are to be considered:

- effects on ballast tank coatings;
- effects on existing piping, fittings and valves;
- hazardous area classification;
- structural strength and integrity of hull;
- fail-safe condition, location and arrangement of isolation valves;
- accumulation of flammable or toxic gases;
- storage and handling of chemicals or reactive materials.

■ *Section 7*
Piping systems

7.1 General

7.1.2 Piping systems which carry chemical substances are to meet the requirements of Ch 5 and 6 of the Rules for Ships for Liquid Chemicals. Use of non-metallic materials will ~~require special consideration~~ be specially considered.

7.1.4 Piping systems utilising plastic pipes are to meet the requirements of ~~*Table 12.5.3 Fire endurance requirements* in~~ *Pt 5, Ch 12 Piping Design Requirements*.

7.2 Side stream piping

7.2.1 Side stream piping is to meet the requirements of *Pt 5, Ch 25, 7.1 General* and the piping which carries concentrated treatment is also to meet the requirements of *Pt 5, Ch 25, 7.2 Side stream piping 7.2.2* to *Pt 5, Ch 25, 7.2 Side stream piping ~~7.2.4~~ 7.2.5*.

7.2.3 Pipe joints are to be of welded type except for connections to shut-off valves, double-walled pipes, or pipes in ducts equipped with mechanical exhaust ventilation.

Existing paragraphs 7.2.3 *to* 7.2.4 *have been renumbered* 7.2.4 *to* 7.2.5*.*

■ *Section 8*
Mechanical equipment and components

8.1 General

8.1.4 ~~De-gassing equipment is to demonstrate that the risk of leakage is prevented.~~ Risk of leakage from degassing equipment is to be prevented. Vent arrangements are to be directed to ~~a safe~~ ~~location~~ an area on open deck with no ignition hazard. ~~A safe location is a location that in the absence of a vent would be non-hazardous. Hazardous area classification is to be conducted for the area surrounding the openings of such vents.~~

8.1.5 Degassing equipment shall be made of a suitable material. Non-metallic materials may be allowed for components inside degassing equipment subjected to special consideration.

8.1.6 Degassing equipment shall be arranged to ensure any hydrogen present is at a concentration less than the 4 per cent Lower Explosive Limit (LEL) before venting. Failure of such arrangement is to activate BWTS shutdown.

8.2 Filtering units

8.2.4 Where filters are provided with a by-pass arrangement as per ~~*Pt 5, Ch 25, 11.3 By-pass and isolation arrangement*~~ *Pt 5, Ch 25, 11.2 Installation requirements*, above requirements *Pt 5, Ch 25, 8.2 Filtering units 8.2.2* and *Pt 5, Ch 25, 8.2 Filtering units 8.2.3* may be exempted.

■ *Section 9*
Electrotechnical Systems

9.1 General

9.1.3 A gas detection system with audible and visual alarm is to be provided for spaces, ~~containing BWT equipment, which may present a hazardous atmosphere~~ where dangerous gas could be present. For flammable atmospheres, the BWTS shutdown is to be activated at a flammable concentration of not more than 60 per cent of LEL. The alarm is also to be provided on the bridge, at manned ballast water control station(s) and in the engine control room, as applicable. Audible and visual alarm signals are to be activated both locally and at the control station(s) when the flammable concentration reaches a pre-set value, which should not be higher than 30 per cent of the LEL of the product concerned. ~~BWTS shutdown is to be activated at a concentration of not more than 40 per cent of Lower Explosive Limit (LEL).~~

9.1.5 Failure of a BWTS power or control system is not to render the BWTS hazardous and is not to affect the operation of essential ~~systems~~ services.

9.1.7 Failure of power or control systems is not to impair or restrict the by-pass or isolation arrangements or alternatively, it is to be demonstrated that fail-safe arrangement of valves is available to ensure the function of by-pass and isolation arrangements.

9.1.8 By-pass and isolation valves are to be provided with position indicators to give remote indication of valve positions.

9.1.9 Activation of by-pass or isolation arrangements is to activate an alarm in all stations from which the ballast water operations are controlled and on the navigating bridge, and be automatically recorded in control equipment.

9.1.10 Electric and electronic components are not to be installed in a hazardous area unless they are of certified safe type for use in the area. Cable penetrations of decks and bulkheads are to be sealed when a pressure difference between the areas is to be maintained.

9.1.11 Deviation from normal working pressure in ballast tanks is to activate an alarm and is to shut down the BWTS. The pressure at which shutdown is to occur is to be set in accordance with the tank manufacturer’s recommendations.

■ *Section 10*
Structural and Space categorisation requirements

10.2 Ballast tanks requirements

10.2.1 ~~Tanks~~ Ballast tanks which could be subjected to over- or under-pressure are to be fitted with ~~Pressure-Vacuum~~ P/V valves and a means of pressure measurement. ~~Deviation from normal working pressure is to activate an alarm and is to shut down the BWTS. The pressure at which shutdown is to occur is to be set in accordance with the tank manufacturer's recommendations.~~

10.3 Chemical storage tank requirements

10.3.5 Chemical storage tanks are to have sufficient strength and to be constructed in such a manner that maintenance and inspection can be easily performed.

10.4 BWTS space categorisation requirements

10.4.2 For BWTS which generates or uses hazardous materials, the following mitigation measures of *Pt 5, Ch 25, 10.4 BWTS space categorisation requirements 10.4.3 to* ~~*Pt 5, Ch 25, 10.4 BWTS space categorisation requirements 10.4.6*~~ *Pt 5, Ch 25, 10.4 BWTS space categorisation requirements 10.4.5* are to be complied with, as applicable.

~~10.4.5 Vent arrangement is to be provided to discharge hazardous gas to a safe location on open deck in the event of failure of the BWTS as in *Pt 5, Ch 25 10.4 BWTS space categorisation requirement 10.4.3*.~~

Existing paragraph 10.4.6 *has been renumbered* 10.4.5*.*

(Part only shown)

Table 25.10.1 Space categorisation and installation requirements

Note 3. For BWTS using ozone generators or electro chlorination with ~~de-gas~~ degassing equipment, six (6) are to be replaced with twenty (20) air changes per hour. BWTS shutdown is to be activated upon failure of the ventilation system.

■ *Section 11*
System arrangement requirements

~~11.2 Installation requirements~~

~~11.2.1 BWTS are to be installed to ensure that the treatment system can be efficiently isolated from the ballast water system without impairing ballast water flow.~~

~~11.2.2 Transfer of ballast between gas-safe areas and ballast tanks immediately adjacent to cargo tanks which carry either flammable liquids of a flash point not exceeding 60 degrees or liquefied chemicals in bulk is not permitted, unless otherwise stated in this Section. Ballast arrangements on ships carrying liquefied gases in bulk will be subject to special consideration.~~

~~11.2.3 Gas-safe areas are not to be rendered hazardous by the use of the BWTS or the connection with the ballast system as indicated above, *see Pt 5, Ch 25, 11.2 Installation requirements 11.2.2*.~~

~~11.3~~ 11.2 By-pass and isolation ~~arrangement~~

11.2.1 The BWTS is to be provided with by-pass and isolation valves as necessary in order that it can be isolated from the ballast water system and any other essential services to which it may be connected without impairing ballast water flow.

~~11.3.1 The BWTS is to be provided with isolation valves to effectively isolate it from any essential ship systems to which it is connected.~~

~~11.3.2 By-pass valves, if fitted, *see Pt 5, Ch 25, 4.2 Ballast Water Treatment Systm ship specific installation appraisal 4.2.5*, are to be accompanied by isolation valves to effectively by-pass and isolate the system.~~

~~11.3.3~~ 11.2.2 By-pass and isolation valves are to be provided with remote means of operation and are also to comply with the requirements of *Pt 5, Ch 12, 6.1 Design requirements 6.1.3*, *Pt 5, Ch 12, 6.1 Design requirements 6.1.4* and *Pt 5, Ch 13, 2.3 Valves − Installation and control*.

~~11.3.4 Failure of power or control systems is not to impair or restrict the by-pass or isolation arrangements or alternatively is to be demonstrating that the fail safe arrangement is in place to ensure the function of by-pass and isolation arrangements.~~

~~11.3.5 By-pass and isolation valves are to be provided with position indicators to give remote indication of valve position.~~

~~11.3.6 Activation of by-pass or isolation arrangements is to activate an alarm in all stations from which the ballast water operations are controlled and on the navigating bridge.~~

~~11.3.7~~ 11.2.3 ~~Isolation and by-pass~~ By-pass and isolation valves are to be placed in easily accessible positions.

11.2.4 The by-pass and isolation arrangement are to meet Electrotechnical requirements of *Pt 5, Ch 25, 9.1 General* as applicable.

~~11.4~~ 11.3 Ballast arrangement between hazardous and non-hazardous area

~~11.4.1 Conditions for BWTS connecting with ballast water serving hazardous and non-hazardous areas are to meet the requirements of *Pt 5, Ch 25, 11.4 Ballast arrangement between hazardous and non-hazardous area 11.4.2* to *Pt 5, Ch 25, 11.4 Ballast arrangement between hazardous and non-hazardous area 11.4.6*.~~

11.3.1 The transfer of ballast water from hazardous to non-hazardous areas is not permitted except for sampling, *see Pt 5, Ch 25, 11.4 Ballast water sampling/analysis unit*. Ballast arrangements on ships carrying liquefied gases in bulk will be subject to special consideration.

11.3.2 Non-hazardous areas are not to be rendered hazardous by the use of the BWTS or its connections with the ballast system.

~~11.4.2~~ 11.3.3 Ballast water piping for the discharge ~~from~~ of ballast tanks ~~with~~in ~~the~~ hazardous areas is not to be connected with the ballast water piping serving tanks in ~~the~~ non-hazardous areas.

~~11.4.3 Ballast water for sampling/analysing may be allowed into non-hazardous areas, provided that sampling or analysing systems meet the requirements of *Pt 5, Ch 25, 11.4 Ballast arrangement between hazardous and non-hazardous area 11.4.6*.~~

~~11.4.4~~ 11.3.4 Ballast water piping serving tanks in non-hazardous areas may be used to fill the ballast tanks in hazardous areas, provided that ~~two non-return valves are installed in series. One of them is to be of a screw-down non-return type.~~ an appropriate isolation arrangement is applied. Means of appropriate isolation are as follows:

(a) two screw-down check valves in series with a spool piece; or
(b) two screw-down check valves in series with a liquid seal which is at least 1,5 m in depth; or
(c) double block and bleed valves and a non-return valve.

~~11.4.5~~ 11.3.5 All ~~pipe penetrations from the~~ piping connections between non-hazardous areas ~~to the~~ and hazardous areas are to be led above main deck level.

11.4 Ballast water sampling/analysis unit

~~11.4.6 Conditions for transferring ballast water from hazardous areas to non-hazardous areas, for the purpose of sampling/analysing, are to comply with the requirements of *Pt 5, Ch 25, 11.4 Ballast arrangement between hazardous and non-hazardous area 11.4.7* to *Pt 5, Ch 25, 11.4 Ballast arrangement between hazardous and non-hazardous area 11.4.13*, as minimum.~~

~~11.4.7~~ 11.4.1 The ballast water sampling/~~analysing~~ analysis unit is to be ~~located~~ installed within a gas-tight enclosure and provided with mechanical ventilation. ~~Exhaust~~ The ventilation outlet is to be led to ~~a safe~~ an area on ~~the ship~~ open deck with no ignition hazard.

~~11.4.8~~ 11.4.2 ~~A remotely-operated stop valve is to be installed in the cabinet for each sample pipe~~ Sampling pipes are to be provided with remotely-operated stop valves installed within the gas tight enclosure.

~~11.4.9 A gas detection device is to be installed in the cabinet as per *Pt 5, Ch 25, 9.1 General 9.1.4* and, upon detection, an audible and visual alarm is to be activated at the relevant control station and the above stop valve is to be automatically closed.~~

~~11.4.10 Audible and visual alarms are to be connected to the control system and activated upon detection of an explosive gas concentration, i.e. not more than 40 per cent of the Lower Explosive Level (LEL) or upon failure of the mechanical ventilation system.~~

~~11.4.11~~ 11.4.3 Pipes are to be ~~of~~ manufactured from steel or equivalent. ~~Alternative material is subject to special approval. It should also meet the requirements of *Pt 5, Ch 25, 7.2 Side stream piping*~~.

~~11.4.12~~ 11.4.4 ~~The~~ Sampling return pipes ~~is~~ are to be provided with ~~a~~ non-return valves, ~~to prevent reverse flow~~ water seals or equivalent arrangement, installed on the hazardous area side of the return pipe in order to prevent backflow.

~~11.4.13~~ 11.4.5 ~~The suction and return~~ Sampling pipes are to be provided with stop valves installed close to the penetration of the bulkhead ~~at~~ within the ~~gas safe side~~ non-hazardous area. A warning notice stating, ‘Keep valve closed when not performing sampling’ is to be posted near the valves.

11.4.6 Sampling pipes are to have an internal diameter which is the minimum standard diameter necessary to achieve the functional requirements of the sampling system.

11.4.7 The sampling/analysis unit is to be installed as close to the bulkhead as possible, and the length of the measuring pipe in any non-hazardous area is to be as short as possible.

11.4.8 Sampling pipes are to be provided with safety valves installed on the hazardous area side of each sampling pipe.

11.4.9 Sampling piping is to be protected against mechanical damage.

11.4.10 The ballast water sampling/analysis unit is to meet Electrotechnical requirements of *Pt 5, Ch 25, 9.1 General* as applicable.

■ *Section 12*
Fire safety requirements

12.1 General

12.1.3 Where the BWTS is installed in an independent compartment, the compartment is to be:

(a) provided with fire integrity equivalent to machinery space of category A or other machinery spaces as applicable; and

(b) positioned outside of any combustible, corrosive, toxic, or hazardous areas unless otherwise specifically approved.

Part 6, Chapter 1
Control Engineering Systems

■ *Section 1*
General requirements

1.3 Documentation required for supporting evidence

1.3.1 For optical fibre data communication systems:

(a) details of manufacturer’s installation and maintenance recommendations;

(b) data communications network diagram; and

(c) details of the minimum power levels required to maintain the correct operation of the data communications system, which is to include an allowance for the effects of optical fibre degradation due to aging.

Existing sub-Sections 1.3 *to* 1.5 *have been renumbered* 1.4 *to* 1.6.

Part 6, Chapter 2
Electrical Engineering

■ *Section 1*
General requirements

1.11 Location and construction

1.11.2 Laser light sources for optical fibre systems are to be constructed in accordance with IEC 60825-1, *Safety of laser products – Part 1: Equipment classification and requirements*. Acceptance of alternative standards will be subject to consideration by LR.

1.11.3 Optical fibre communication systems are to be constructed in accordance with IEC 60825-2, *Safety of laser products – Part 2: Safety of optical fibre communication systems*. Acceptance of alternative standards will be subject to consideration by LR.

Existing paragraphs 1.11.2 *to* 1.11.14 *have been renumbered* 1.11.4 *to* 1.11.16*.*

■ *Section 9*
Rotating machines

9.1 General requirements

9.1.2 The insulation systems of electrical rotating machines used for essential services are to be tested following the principles detailed in IEC 60505*, Evaluation and qualification of electrical insulations systems*, or an equivalent International or National Standard acceptable to LR.

Paragraphs 9.1.2 *to* 9.1.20 *have been renumbered* 9.1.3 *to* 9.1.21.

(*Part only shown*)
~~9.1.14~~ 9.1.15 For high voltage machines, the stator insulation system is to be of a type that has undergone type testing in accordance with the following International Standards, or relevant alternatives acceptable to LR, to demonstrate its suitability for the operating voltage:

(e) ~~IEC TR 60894, *Guide for test procedure for the measurement of loss tangent of coils and bars for machine windings*, at the *insulation class rated temperature and ambient temperature.*~~ IEC 60034-27-3, *Dielectric dissipation factor measurement on stator winding insulation of rotating electrical machines.*

(*Part only shown*)
~~9.1.16~~ 9.1.17 Sample coils for use in the machines detailed in *Pt 6, Ch 2, 9.1 General requirements 9.1.14* are to be type tested and subsequently routinely tested in accordance with the following International Standards, or relevant alternatives acceptable to LR. The interval between routine tests is to be agreed with LR, and testing is to be witnessed by an LR Surveyor:

(a) ~~IEC TR 60894, *Guide for test procedure for the measurement of loss tangent of coils and bars for machine windings*, at ambient temperature~~ IEC 60034-27-3, Dielectric dissipation factor measurement on stator winding insulation of rotating electrical machines; and

9.8 Survey and testing

9.8.7 The partial discharge characteristics of the high voltage rotating machines for essential services are to be measured and recorded in accordance with *Pt 6, Ch 2, 21.4 Partial discharge testing of high voltage rotating machines for essential services*.

■ *Section 11*
Electric cables, optical fibre cables and busbar trunking systems (busways)

11.2 Testing

(*Part only shown*)
11.2.1 Routine tests, consisting of at least:

(d) for high voltage cables, partial discharge tests are to be made in accordance with the requirements of IEC 60885-2: *Electrical test methods for electric cables – Part 2: Partial discharge tests*, or an acceptable and relevant National Standard, at the manufacturer's works prior to despatch; and

(e) for optical fibres, an attenuation loss (*see Pt 6, Ch 2, 21.6 Optical Fibre Communications Systems*).

11.8 Installation of electric and optical fibre cables

11.8.3 The manufacturer’s tensile load limit of the optical fibre is not to be exceeded during installation.

11.8.4 The manufacturer’s minimum bend radii for optical fibres is not to be exceeded during installation.

11.8.5 Pre- and post-installation tests are to be conducted on optical fibre cables as detailed in *Pt 6, Ch 2, 21.6 Optical Fibre Communications Systems*.

Existing paragraphs 11.8.3 *to* 11.8.22 *have been renumbered* 11.8.6 *to* 11.8.25.

■ *Section 14*
Electrical equipment for use in explosive gas atmospheres or in the presence of combustible dusts

14.2 Selection of equipment for use in explosive gas atmospheres

14.2.9 Where optical fibre transmission equipment located in a hazardous or non-hazardous area provides energy to, or passes optical energy through, a hazardous area with an explosive gas atmosphere, then:

(a) The protection type to be appropriate to the zone classification, as detailed in *Table 5.4.1 Zone classification for types of protection associated with optical fibre transmission systems*.
(b) The optical energy levels in zone 0 and 1, including fault conditions, are to be limited to 5mW/mm^2 or 35mW for constant wave and 0,1mj/mm^2 pulsed.
(c) The optical energy levels in zone 2, including fault conditions, are to be limited to 10mw/mm^2 or 35mW for constant wave and 0,5mj/mm^2 pulsed, and
(d) Pulsed sources with a pulse interval less than 5 seconds, are to be considered constant wave sources.

Existing paragraph 14.2.9 *has been renumbered* 14.2.10.

Table 5.14.1 Zone classification for types of protection associated with optical fibre transmission systems

Zone	Type of protection allowed	Associated requirements
0	'op is', Inherently safe optical radiation,	Safe with two faults
	'op sh', Protected fibre optic media with ignition capable beam	additional mechanical protection required
1	'op is', Inherently safe optical, radiation	Safe with single fault
	'op pr', Protected fibre optic media with ignition capable beam	with additional mechanical protection required
	'op sh', Protected fibre optic media with ignition capable beam interlocked with fibre breakage	additional mechanical protection not necessarily required
2	'op pr', inherently safe optical radiation, 'op is'	Safe in normal operation
	'op pr', Protected fibre optic media with ignition capable beam	additional mechanical protection not necessarily required
	'op sh', Protected fibre optic media with ignition capable beam interlocked with fibre breakage	additional mechanical protection not necessarily required

14.3 Selection of equipment for use in the presence of combustible dusts

14.3.2 Where optical fibre transmission equipment located in a hazardous area, extended hazardous area or non-hazardous area provides energy to, or passes optical energy through, a hazardous area with combustible dusts, then the optical energy levels are to be:
(a) restricted in hazardous area to 5mW/mm^2 or 35mW maximum for constant wave sources or 0,1mj/mm^2 for pulsed sources;
(b) restricted in extended hazardous area to 10mW/mm^2 or 35mW maximum, for constant wave sources or 0,5mj/mm^2 for pulsed sources;
(c) where pulsed source has a pulse interval less than 5 seconds, it is to be considered constant wave source.

Existing paragraphs 14.3.2 to 14.3.5 have been renumbered 14.3.3 to 14.3.6.

■ *Section 21*
Testing and trials

21.2 Trials

21.2.2 The insulation resistance is to be measured of all electrical power circuits and electrical equipment, using a direct current insulation tester, between:
(a) all current-carrying parts connected together and earth and, so far as is reasonably practicable;
(b) all current-carrying parts of different polarity or phase.
The minimum values of test voltage and insulation resistance are given in *Table 2.21.2 Test voltage and minimum insulation*. The installation may be subdivided and appliances may be disconnected if initial tests produce results less than these figures.

21.4 Partial discharge testing of high voltage rotating machines for essential services

21.4.1 To enable future trend analysis, on completion of harbour acceptance trials or during sea acceptance trials, partial discharge measurements are to be conducted which will baseline the partial discharge characteristics of the rotating machine. A copy of the test report is to be retained on board and made available to the Surveyor on request.

21.4.2 At the first Annual Survey, or within 3 months of the due date, the partial discharge measurements required by *Pt 6, Ch 2, 21.4 Partial discharge testing of High voltage rotating machines for essential services 21.4.1* are to be repeated. A copy of the test report is to be retained on board and made available to the Surveyor on request.

21.4.3 At Complete Survey, or within 3 months of the due date, the partial discharge measurements required by *Pt 6, Ch 2, 21.4 Partial discharge testing of High voltage rotating machines for essential services 21.4.1* are to be repeated. A copy of the test report is to be retained on board and made available to the Surveyor on request.

21.4.4 The partial discharge measurement method to be used is to be acceptable to the rotating machine manufacturer. Particular attention is to be given to ensuring that:

(a) the test voltage and frequency (i.e. ac, dc or ultra-low frequency and voltage level), and method selected are to be compatible with the insulation systems; and
(b) the tests do not over stress or cause accelerated aging of the insulation system.

21.4.5 The measurements required by *Pt 6, Ch 2, 21.4 Partial discharge testing of High voltage rotating machines for essential services 21.4.1 to Pt 6, Ch 2, 21.4 Partial discharge testing of High voltage rotating machines for essential services 21.4.3* are to be conducted and recorded in accordance with one of the following standards as appropriate to the design and application of the rotating machine:

(a) Off-line testing:
- IEC TS 60034-27, *Rotating electrical machines – Part 27: Off-line partial discharge measurements on the stator winding insulation of rotating electrical machine;*

(b) On-line testing:
- PD IEC/TS 60034-27-2:2012, *Rotating electrical machines Part 27-2: On-line partial discharge measurements on the stator winding insulation of rotating electrical machines*;
- DD IEC/TS 61934:2011, *Electrical insulating materials and systems — Electrical measurement of partial discharges (PD) under short rise time and repetitive voltage impulses*; or
- an alternative International or National Standard acceptable to LR.

21.4.6 The test reports required by *Pt 6, Ch 2, 21.4 Partial discharge testing of High voltage rotating machines for essential services 21.4.1 to Pt 6, Ch 2, 21.4 Partial discharge testing of High voltage rotating machines for essential services 21.4.3* are to record the method and equipment used in sufficient detail to ensure the tests can be repeated consistently throughout the service life of the rotating machine.

21.4.7 The test reports required by *Pt 6, Ch 2, 21.4 Partial discharge testing of High voltage rotating machines for essential services 21.4.1 to Pt 6, Ch 2, 21.4 Partial discharge testing of High voltage rotating machines for essential services 21.4.3* are to include, but are not limited to, the details recommended by the test standard to be applied. *See Pt 6, Ch 2, 21.4 Partial discharge testing of High voltage rotating machines for essential services 21.4.5*.

21.4.8 The documentation required by *Pt 6, Ch 2, 21.4 Partial discharge testing of High voltage rotating machines for essential services 21.4.6* is to be provided to the end user as part of the as-built documentation for the rotating machine.

21.4.9 Partial discharge measurements are to be evaluated by suitably qualified and experienced personnel, and are to remain within the manufacturer's recommendations.

21.4.10 Where partial discharge measurements exceed the manufacturer's recommendations, corrective action is to be taken.

21.4.11 Where on line partial discharge monitoring equipment is installed, which is capable of being used to alert the ship's staff of an increase in partial discharge activity, then the output is to be included as an alert, with alert levels set, and the actions required to be specified by the manufacturer of the rotating machine.

Existing sub-Section 21.4 *has been renumbered* 21.5.

21.6 Optical Fibre Communications Systems

21.6.1 The attenuation loss of single-mode optical fibre is to be tested prior to installation in accordance with IEC 61280: *Fibre-optic communication subsystem test procedures Part 4-2: Installed cable plant – Single-mode attenuation and optical return loss measurement*. The test is to be recorded in accordance with the standard. The documentation is to be retained on board and made available to the Surveyor on request. Acceptance of alternative standards will be subject to consideration by LR.

21.6.2 The attenuation loss of multi-mode optical fibre is to be tested prior to installation in accordance with IEC 61280: *Fibre optic communication subsystem test procedures – Part 4-1: Installed cable plant — Multimode attenuation measurement.* The test is to be recorded in accordance with the standard. The documentation is to be retained on board and made available to the Surveyor on request. Acceptance of alternative standards will be subject to consideration by LR.

21.6.3 The tests required by *Pt 6, Ch 2, 21.6 Optical Fibre Communications Systems 21.6.1* and *Pt 6, Ch 2, 21.6 Optical Fibre Communications Systems 21.6.2* are to be repeated after installation using the same method as used for the pre-installation test. The test is to be recorded in accordance with the standard; the documentation is to be retained on board and made available to the Surveyor on request. Acceptance of alternative standards will be subject to consideration by LR.

21.6.4 The results of the testing required by *Pt 6, Ch 2, 21.6 Optical Fibre Communications Systems 21.6.3* are to be validated against the communication system design specification to ensure that adequate optical power will be transmitted for correct system operation, *see Pt 6, Ch 1, Documentation required for design review 1.2.10*.

Part 7, Chapter 11
Arrangements and Equipment for Environmental Protection (ECO Class Notation)

■ *Section 3*
Supplementary characters

3.3 Ballast water treatment – BWT characters

3.3.1 Where a ballast water treatment system is installed, the character **BWT** will be assigned, provided that the treatment system is installed, utilised and approved in accordance with Resolution MEPC.174(58) – Guidelines for Approval of Ballast Water Management Systems (G8) – (Adopted on 10 October 2008) or Resolution MEPC.125(53) - Guidelines for Approval of Ballast Water Management Systems (G8) - (Adopted on 22 July 2005) and *Pt 5, Ch 25 Ballast Water Treatment System and Installation.*

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